Influence of forest road on breeding of tits in artificial nest boxes

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ABSTRACT: A study was conducted to determine the influence of forest road on breeding of tits in artificial nest boxes in deciduous, coniferous and mixed forests in the Gwanak Arboretum (37° 25' 05" N, 126° 56' 85" E) of Seoul National University, Anyang, Korea from November 2002 to June 2003. Three tits species, varied tit (*Parus varius*), marsh tit (*P. palustris*) and great tit (*P. major*), breeding in artificial nest boxes were investigated on number of breeding pairs, cultch size, and egg measurement. Resuls showed that the breeding pairs of varied tit was more in 75–150 m area than in 0–75m area from forest road for all the three study sites, and the clutch size and egg measurements (weight, Major axis and Minor axis) of varied tit was also higher in the area of 75–150 m than in the area of 0–75 m, while no differences in number of breeding pairs and clutch size were found for marsh tit and great tit between the two areas. Egg measurement of great tit was also higher in forest interior area than in forest edge area. It is concluded that varied tit were most significantly influenced by forest road, followed by great tit, whereas marsh tit were not influenced by forest road. Artificial nest box is roved to be good for cavity nester in disturbed areas by human activities. Supply of artificial nest can help population protection and management of bird species.

Keywords: Artificial nest boxes; Breeding; Forest road; Tits
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Introduction

In many parts of the world, increased human activity has altered the original landscape to a series of small, isolated patches of natural habitats, surrounded by a matrix of different vegetation and/or land use. This results in reduction of the quality of the remnant patches, thus affecting populations of organisms inhabiting them (Saunders *et al.* 1991, Opdam 1991, Nour *et al.* 1998). A number of studies have considered the effects of habitat fragmentation on bird populations, including changes in species composition and abundance, predation, food availability and genetic variation (Riddington and Gosler 1995, Robinson *et al.* 1995).

Roads can create habitat fragmentation and facilitate fragmentation through human exploitative activities (Trombulak and Frissell 2000). Roads contribute to biodiversity loss, both directly via animal mortality related to traffic, and indirectly through the destruction and fragmentation of habitats. Also forest road has effect on wildlife, but its influence is less than paved road for vehicles. Forest edges occur in a variety of contexts to forest birds (Saracco and Collazo 1999). For example, edges may be in the interior (e.g., clearcutting within contiguous forest) or along the interior (e.g., agricultural encroachment from outside) of forest. And they would exhibit varying degrees of contrast from subtle to abrupt (Suarez *et al.* 1997).

Bird reproduction in seasonal environments generally subject to a steady seasonal decline in number of young fledged and in the probability that fledglings will recruit into the breeding population. Thus, factors determining the start of breeding are of great importance for the reproductive success of individuals (Nilsson and Raberg 2001). Clutch size can be adjusted to environmental resources and brood size and offspring quality may reflect phenotypic (environmental) variation (Rytkonen 2002).

Many researchers have used artificial nest boxes to examine the breeding biology and life history of bird species. Nest-box programs are normally considered an effective conservation tool for bird species (Park *et al.* 2004). Much information on birds nesting in artificial nest boxes will allow further understanding of the factors that regulate populations of cavity nesting birds and influence community structure (Purcell *et al.* 1997).

This paper examines the influence of forest road on breeding of three tit species in artificial nest boxes.

Methods

This study was conducted on the Gwanak Arboretum (37° 25' 05" N, 126° 56' 85" E) of Seoul National University in Anyang, Korea from November 2002 to June 2003. The area is characterized by natural deciduous forest, planted coniferous forest and mixture of natural deciduous and planted coniferous forests. Dominant tree species were *Quercus mongolica, Styrax japonica, Q. serrata, Pinus rigida,* and *P. densiflora* in the study area (Park 2003).

Three study sites (150 m x 210 m) were selected separately in deciduous, coniferous and mixed forests beside forest road. Each study site was divided into grids consisting of a 30m x 30m array marked with flags, facilitating accurate nest boxes location. Forty eight nest boxes were placed in each site. Nest boxes with different entrance diameter such as 3 cm, 3.5 cm and 4 cm for different body size of cavity nesting birds were located at 1.5-2 m above ground in various diameters of trees. From April to June 2003, the artificial nest boxes used was investigated every week. Clutch size, major and minor axis, weight of eggs were measured.

Results and discussion

Three tits species, varied tit (*Parus varius*), marsh tit (*P. palustris*) and great tit (*P. major*) were observed on breeding in

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artificial nest boxes in this study. It was found that the number of breeding pairs of marsh tit was similar to that of great tit for using artificial nest boxes between 0–75 m and 75–150 m areas in deciduous, coniferous and mixed forests. However, the breeding pairs of varied tit was more in 75–150 m area than in 0–75m area for all the three study sites (Table 1).

Table 1. Number of breeding pairs of three tits species using artificial nest boxes in the areas 0–75 m and 75–150 m from forest road in different forest type

Forest type	0–75 m from forest road			75–150 m from forest road		
	P. varius	*P. palustris*	*P. major*	*P. varius*	*P. palustris*	*P. major*
Deciduous forest	-	2	2	5	1	3
Coniferous forest	1	1		3	1	-
Mixed forest	1	1	2	4	1	2

The clutch size of varied tit was higher in the area of 75–150 m from forest road than in the area of 0–75 m, while no differences in clutch size were found for marsh tit and great tit between both areas (Table 2).

Table 2. Clutch size of three tits species using the artificial nest boxes in the areas of 0-75m and 75-150 m from forest road

Species	0-75m area	75-150m area	Z-value	P-value
P. varius	4.50±0.71*	6.33±1.23	-5.64	< 0.01
P. palustris	5.00±0.82	5.33±0.58	1.52	0.1
P. major	5.50±1.29	5.40±1.14	1.97	0.15

* Mean±SE

Marsh tits' eggs did not have significant difference in weight, major axis, and minor axis between the areas of 0–75m and 75–150 m from forest road. However, the egg measurements of varied tit, and great tit were significantly higher in 75–150 m area than in 0–75m area (Table 3).

Table 3. Egg measurements of three tits species in artificial nest boxes in the areas of 0–75 m and 75–150 m from forest road

Egg measurements	0-75m area	75-150 m area	Z-value	P-value
P. varius				
Weight (g)	1.47±0.24	1.56±0.26	-3.67	0.01
Major axis (mm)	16.24±0.68	16.71±0.75	-3.52	0.01
Minor axis (mm)	12.52±0.42	13.04±0.51	-2.67	0.02
P. palustris				
Weight (g)	1.12±0.13	1.10±0.17	0.21	0.1
Major axis (mm)	15.48±0.47	15.45±0.71	2.73	0.2
Minor axis (mm)	11.93±0.64	11.79±0.53	1.24	0.1
P. major				
Weight (g)	1.42±0.27	1.59±0.76	-2.75	0.05
Major axis (mm)	16.34±0.24	16.82±0.69	-3.82	0.01

* Mean±SE

Varied tit preferred forest interior to forest edge areas (Table 1). Its clutch size and egg measurement were higher in forest interior than in forest edge (Table 2 and 3), which means that varied tit were influenced by forest road on nesting location, clutch size and egg weight and size. Egg measurement of great tit was also higher in forest interior areas (Table 3).

Riddington and Gosler (1995) concluded that tit reproductive success was poorer in presumed marginal habitats which included small woodlots but also gardens and hedgerows, and suggested that environmental quality was the primary constant.

Varied tit and great tit were influenced by forest road but marsh tit were not. In disturbed areas by human activities, artificial nest boxes would be good for cavity nester. Artificial nest boxes are also valuable for conservation programs aimed at augmenting target species' abundance, having increased populations for many species (Eadie *et al.* 1998, Matthew *et al.* 2002). Supply of artificial nest could help for population protection and management of bird species (Zanette 2002).

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